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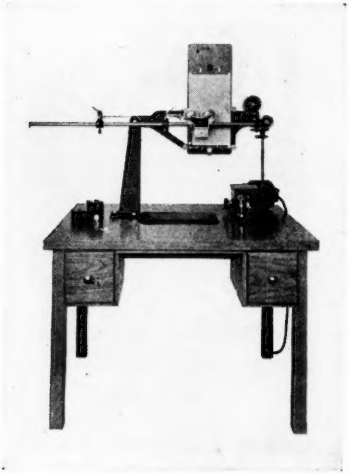

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TESTERS

The Editor's Page

Annual Meeting and Dinner

THE annual meeting and dinner of the Institute will be held Thursday, November 10, at the Hotel Commodore, New York, N. Y., and the afternoon will be devoted to a conference on the subject of cotton and spun rayon warp sizing which will be open to all who may be interested in the organization and co-operative financing of such a study.

The annual meeting of the corporation will be held at 11 A.M., the warp sizing conference at 2 P.M., and the dinner at 7 P.M. A luncheon meeting of the Board of Directors is scheduled for 12:30 P.M.

The selection of Thursday, Nov. 10, as the date for the meeting, instead of the first Thursday in that month, was deemed necessary in order to secure certain features of unusual importance for the dinner speaking and entertainment program. Pending the results of these efforts the stated meeting date is somewhat tentative, but as soon as program details are definitely decided they will be mailed to members.

The following committees for the annual meeting were appointed at a meeting of the Board of Directors held in New York Sept. 20: Nominating Committee—Ephraim Freedman, Chm., Earl Constantine, Alban Eavenson, Dr. H. DeW. Smith, Douglas G. Woolf. Budget Committee—Dr. H. DeW. Smith, Chm., Fessenden S. Blanchard, Charles H. Clark.

* * *

Warp Sizing Study May Go South

CO-OPERATORS in the Institute's warp sizing project have recommended to the Research Council that the research be reorganized for the study of cotton and spun rayon sizing and their sizing materials.

This was the result of a meeting called by the Council and held in New York, N. Y., Sept. 9, at which the resignation of Director Yelland and of the withdrawal of financial support by The Textile Foundation, and their effect upon the future of the project were discussed. Since the present study of the warp sizing of filament viscose rayons is practically completed, and since a new director and additional money would be needed if the sizing of acetate rayons was to be undertaken, it was the consensus of opinion of those present that, because of this and since so little has been done thus far on cottons and spun rayons, a study of these two classes of warps would best serve a majority of the co-operators, and be most likely to serve and win support of the largest number of mills which have not been co-operating.

Because the major part of the cotton textile industry is located in the South, and also a large proportion of the spun rayon branch, the co-operators recommended that the laboratory, and the mills to conduct the experimental research, be located in the South if possible, and that the administration committee for the study be made up of southern men. These recommendations have been approved by the Research Council, and also

by the Board of Directors. Both have also approved the holding of a conference, open to all members of the industry who may be interested, to be held in conjunction with the annual meeting in New York, at 2 P.M., Thursday, Nov. 10. Tentative plans for the study will be presented by the Research Council for discussion, and the conference will be asked to decide whether such a study is wanted, and whether the Institute shall proceed with its organization and financing upon the co-operative basis.

At the conference of co-operators Sept. 9 Director Yelland presented a very complete summary of the results of the research on the warp sizing of viscose rayons since Jan., 1936, when he took charge of the laboratory at Massachusetts Institute of Technology. The results of the research include new methods of laboratory analysis of sizing materials and of sized goods, a relatively simple and reliable method of determining the penetration in viscose warps of gelatin size mixtures, new techniques for sampling sized warps and determining the comparative efficiency of different size mixtures, and, most important of all the results, the proof under controlled mill conditions that the use of certain recommended sizing materials and methods would effect a saving in cost of viscose warp sizing for most mills of 25 to 35%. The latter is the latest result of this research and will not be made public for a year. However, it and all other reports of the study are available to Contributing Members of the Institute who become subscribers to the study by payment of $100. Results of the research that were reported to co-operators a year or more ago will be published in TEXTILE RESEARCH, starting in an early issue.

* * *

DELAYED mails due to hurricane and flood conditions in New England, were responsible for the delayed mailing of this issue, and its somewhat reduced contents. However, if it had been mailed the first of the month as usual, the date and place of the Institute's annual meeting could not have been announced in this issue. Here's hoping no cataclysms of nature will prevent your attendance at that meeting!

* * *

THIS issue marks the start of the ninth fiscal year of U. S. Institute for Textile Research, Inc. The reports to be presented at the annual meeting in November will show how much members have to be thankful for, or to regret. One of the most encouraging features of the year then to be reviewed is the fact that the Institute is no longer obliged to sell research on faith alone, but is able to point to research accomplishments.

* * *

TEXTILE RESEARCH has been the only textile and one of very few scientific publications that have carried no advertising. Its functions have been and are to record and promote textile research, and now that it has opened a restricted portion of its columns to advertising it is merely expanding its basic functions. It is realized that its highly specialized circulation will appeal to few advertisers other than those having research services or research activities to announce. As the net income from such advertising as appears in these columns will help to swell Institute funds available for research, we commend our advertisers to Institute members and *Textile Research* subscribers, and request that in writing to the advertisers they refer to this publication.

(*Continued on page 435.*)

The Flat Bundle Fibre Test

By H. R. BELLINSON*

I. Methods of Measuring Fibre Strength

Single Fibre Test.—Fibre strength may be determined by two methods: by breaking individual fibres, and by breaking bundles of fibres. The individual fibre method has been used almost exclusively by the English workers. But since fibre strength varies so much from fibre to fibre of any group, a large number of fibres will have to be broken to determine the mean strength with reasonable precision. Koshal and Turner [1] find for one type of cotton fibre, a mean strength of 3.91 grams, with 2.357 grams as the standard deviation of the distribution. Had they tested 1,000 fibres, the standard deviation of the mean would have been 1.9%. Consequently, the single fibre test is time consuming, even with the semi-automatic tester developed by Balls.[2, 3]

When the experiment aims at correlating properties of the individual fibres, such as strength and maturity, the single fibre test is essential. But when mass properties are to be correlated, the single fibre test may introduce certain theoretical errors. This is the case in comparing fibre strength to yarn strength. In the ideal case (where no fibre slippage occurs) the load applied to a yarn is distributed among the fibres at any cross-section. As the yarn is strained, the load per fibre increases until the weakest breaks; the load is then redistributed among the remaining fibres, so that with no increase in total load upon the yarn, the load upon the fibre is suddenly increased. As a result, the breaking load will be considerably less than the average breaking strength of the fibres present. The yarn breaking strength might be expected to be a function of the number of weak fibres present, thus of the distribution of fibre strength.

Koshal and Turner [4] have shown that fibre strength is distributed along a Pearson Type I curve.[5] Such a curve is characterized by four constants, of which the mean is only one; so that the yarn strength would be a function of these four constants. Empirical analyses [6, 7] of observed distributions indicate that the yarn or group strength may be 40–60% of the mean fibre strength. However, the necessity for making a large number of tests and for analyzing the distribution would be obviated if the fibres could be satisfactorily tested in groups.

Bundle Tests.—One method of testing fibres in groups was proposed by Chandler.[8, 9] In the Chandler Bundle Method, a bundle of approximately 10,000 fibres is broken as a unit. The fibres are parallelized by combing; the bundle is then placed in two clamps which are separated so that the bundle is under slight tension. One end of a piece of sewing thread is attached to the bundle at each clamp, and a weight suspended in the loop of thread. As both clamps are rotated together, the thread is wound

* Research Assistant, Textile Laboratory, Massachusetts Institute of Technology.

around the bundle. The length of thread required to wrap the bundle ten times is noted, and used to compute the circumference. Chandler recommends a bundle such that this circumference shall be from 0.150 to 0.200 inches.

As the thread is wound on the bundle, it forms a spiral, and the arms of the loop travel to the center of the bundle. After they reach the center, the direction of the spiral is reversed, and although the bundle is rotated in the same direction, the arms of the loop now travel back to the ends of the bundle. As a result the bundle is completely wound with the sewing thread, yet the center remains free. Special jaws for the breaking machine are clamped on each side of this center portion, and since the jaws are in contact during the clamping, the gauge length is essentially zero.

Chandler wishes to convert the strength of the bundle into strength per unit area. The cross-sectional area might be determined from the weight and density of the bundle. It would be necessary to trim the fibres to a uniform length, weigh these, and find the density. The area might also be determined (and more easily) from the circumference. However, this circumference encloses not only the fibres, but also void spaces between and within the fibres. The ratio of fibre area to total area may be computed by taking the ratio of the areas computed in these two ways. Chandler assumes that this ratio is constant under given conditions of preparing the bundles, and finds its value. Thereafter the circumference alone is used.

It should be noted that the two assumptions, (1) density of material is constant, (2) ratio of material area to bundle area is constant, are required to convert bundle strength to strength per unit area or to strength per unit weight.

In one series of tests, bundles equal in weight to that of 10,000 counted fibres were broken. The strength per fibre was found to be 4.68 grams. The average strength of 100 fibres broken individually was 6.70 grams. The bundle strength is apparently 70% that of the individual fibres. However, it should be noted that the gauge length of the bundle was zero, whereas the length of the fibres in the individual tests (although not reported) was probably longer. Since the strength of fibres increases as the breaking length is decreased,[10] the comparable single fibre strength is higher than 6.70 grams, and the realized bundle strength less than 70%.

The essential principles of the Flat Bundle method (cutting the fibres to uniform length, weighing the bundle, and using adhesive material to hold the bundle together) were apparently first used by Crowley.[11] The rapid simplicity of the method is eminently suited to testing in a commercial laboratory. For the same reason, this method was adopted when the Textile Laboratory at M. I. T. found it necessary to compare the strengths of a large variety of cottons, early in 1936. The details reported in this paper were worked out at that time.

II. Flat Bundle Test

Sampling.—Although the final bundles contained some 10,000 cotton fibres, yet this is a small number compared to the number of fibres in one bale. In the present experiment, in order that the samples might be fairly representative, small bundles of fibres were taken from many different parts of the lot; these bundles were put together, and from the mass so obtained a sliver was made and repeatedly drawn and doubled by hand. In

this way, the fibres were thoroughly mixed together, and some degree of straightness and parallelism attained. The final sliver was folded to produce a short thick bundle; this was pulled in two, and from the broken end small tufts were pulled to provide actual bundles.

Combing.—Each such tuft was held near the center with a clamp such as that provided with a Baer stapler. The exposed half of the tuft was then combed to straighten the fibres and remove fibres not extending to the clamp. The tuft was then reversed in the clamp, and the combining repeated on the other end. Care must be taken in this process not to break the fibres, but if the original sliver is prepared so that the fibres are partially straight and parallel, and the tuft taken small enough, no difficulty will be encountered in combing.

Trimming.—Since the strength of a bundle will depend upon the amount of material present, some means must be adopted to determine this. The simplest method is weighing. However, the fibres must first be cut to uniform length. The tuft was therefore cut to ½ in., this length being chosen because, in the case of cotton, a greater length might leave too many fibres uncut, whereas a lesser length would make handling the tuft awkward.

To assure accurate trimming, a steel clamp (Fig. I) was made, of which the upper part was a steel bar ½ in. in width. The tuft of fibres was laid upon a piece of cardboard and clamped; the projecting ends of the fibres could then be easily trimmed off with a razor blade, leaving a tuft which was always just ½ in. long. This method was entirely satisfactory with even such tough fibres as cotton and ramie.

Mounting.—The cut tufts could now be weighed, and two or three such tufts were usually combined to produce a bundle of satisfactory total weight. This bundle is to be held at the ends by drafting tape, but the process of mounting the tape is important. If the bundle is too thick at any point, the fibres will not be properly held, and will slip rather than break. The length of free fibre (the gauge length) affects the strength, and must therefore be controlled accurately. The most important variable that may be introduced in improper mounting is that some fibres may be placed under greater initial tension than the remainder; this will cause the bundle to break at a low load.

A metal plate was prepared with four upright pins placed at the corners of a rectangle 0.75×0.08 in. (Fig. II). The bundle of fibres is placed between the pins, and can be manipulated so that the thickness is uniform. A thin bar fits between the other set of pins, and holds the bundle during the operation of applying the drafting tape. This is done by holding the square end of the tape against the pins above the fibres, and lowering the tape until it is stuck to the fibres. When both projecting ends of the bundle have been attached to tape, the entire bundle may be removed from the pins, turned over, and replaced between the pins so that additional pieces of tape may be attached to the back. The appearance of the mounted bundle is similar to that of the familiar serigraph yarn sample.

Breaking.—The flat fibre bundle is now ready to be broken. This was done on a Scott pendulum type machine. However, it was found that the jaw separation at the beginning of successive breaks was likely to vary. The device adopted to allow adjustment of the jaw separation is shown in Fig. 3. The method of adjustment consisted in raising the lower jaw by turning knob A, placing a C-clamp with 2.08 in. opening over the upper jaw and under the lower jaw, and lowering the lower jaw until the

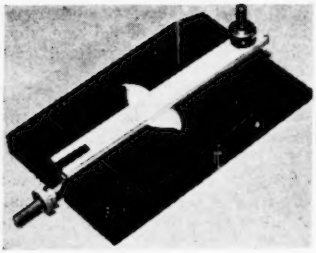

FIG. I. Clamp. Fibre bundle in place, before trimming.

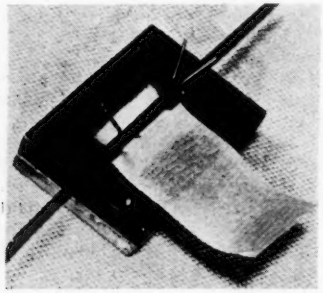

FIG. II. Mounting Plate. Trimmed bundle in place, one strip of drafting tape attached.

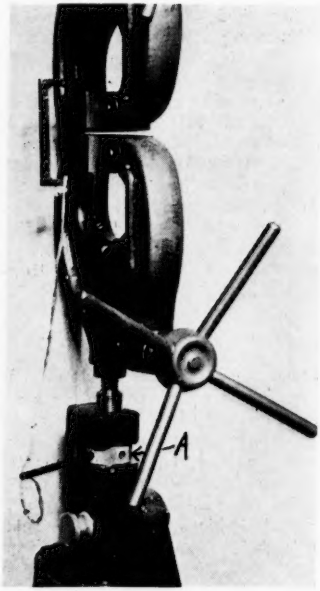

FIG. III. Jaw Adjuster. The C-clamp is shown at the jaws.

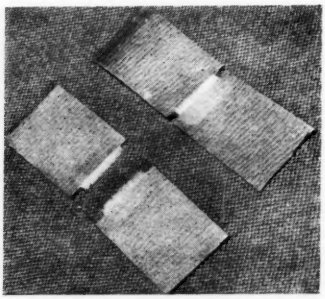

FIG. IV. Specimens.

pointer on the scale of the machine was just deflected. Since each jaw is 1 in. thick, the separation was now 0.08 in. The bundle could now be placed in the jaws, so that the ends of the tape were level with the inner faces of the jaws, and the test performed in the normal manner.

III. Discussion

Gauge Length.—The outstanding departure in the technique here described from that of previously reported methods [8, 9, 11, 12] is the adoption of a finite gauge length. It is a well known fact that the apparent strength of yarns increases as the length tested is decreased. This is also true of single fibres, and probably also of bundle tests, although here the effect may be smaller in magnitude.

A test specimen will break at its weakest point, and the strength recorded is that of this weak point. Regardless of how the weak points are distributed along a fibre or yarn, the number of such points in a test length will increase as the length is increased; and as the number of weak points increases, the probability that a very weak place will be present also increases. The result is that a longer specimen may break at a lesser load.

This effect has been proved experimentally: by Balls,[13] and Midgley and Peirce,[14] in the case of yarns; and by Clegg [10] and Brown, Mann, and Peirce,[15] in the case of single fibres. Peirce [16] examined the theory of the "Weakest Link" mathematically, and his results indicate that for increases in length up to five times the original gauge length, the decrease in strength is very closely proportional to the logarithm of increase in length. The proportionality factor is the standard deviation of strength for the original gauge length and will of course remain constant for a given sample. Table 1, showing the magnitude of the decrease in strength, is taken from Peirce's paper. Since Peirce used the "modulus of precision" as proportionality factor, his values were multiplied by $\sqrt{2}$, to convert to the standard deviation. The values between 1 and 2 were not given by Peirce, but were computed by interpolation. S is the mean strength of a unit length, and σ the standard deviation of strength in a unit length.

TABLE 1

Length	Mean Strength
1	S
1.25	$S-.18\sigma$
1.50	$S-.33\sigma$
2.0	$S-.56\sigma$
3.0	$S-.84\sigma$
4.0	$S-1.03\sigma$
5.0	$S-1.16\sigma$

Navkal and Ahmad [17] find that σ is about 53% of the mean strength for single fibres about 0.8 in. long. (Peirce indicates that σ increases as the gauge length is decreased.)

Although in theory the gauge length might be considered as zero, in actual practice there must be experimental variation in the initial length. Suppose then that the actual gauge length varies from zero to 0.002 in.;

the mean length will then be about .001 in. Thus, there will be experimental errors in gauge length as large as twice the mean length; according to the table, these will introduce errors in strength as high as 0.56σ. It does not matter what the actual experimental error in gauge length is; the maximum length will remain approximately twice the mean length, so that the introduced error remains 0.56σ. If, however, the theoretical gauge length is 0.08 in., and the deviations as high as 0.02 in.; then the table indicates that the introduced error is only 0.18σ. There is consequently considerable advantage in the adoption of a finite gauge length.

The use of .08 in. gauge length in this case was entirely a matter of convenience. In single fibre tests, 1 cm. is used most commonly. But with a bundle only ½ in. long, use of a 1 cm. gauge length would leave only 0.06 in. at each end for the jaws to grip; this is obviously insufficient if the jaws are to grip the fibres properly.

Expression of Results. In the course of the tests, the weight of a bundle of fibres ½ in. long, and the load at which this bundle broke, have been noted. To obtain the strength per gram of fibres, it is only necessary to divide the breaking load by the weight. Thus, if L is the breaking load in pounds, W the weight in milligrams, and S the strength per gram of fibres ½ in. long:

$$S = 1000 \frac{L}{W}$$

Assumptions as to density need be made only if the strength is to be expressed as pounds per unit area.

The strengths of 10 different lots of cotton are presented in Table 2. Five bundles were broken and averaged for each lot. In Table 3, the results on a typical lot are presented in full detail, along with the computation of the mean and the standard deviation.

Number of pounds per gram of fibres ½ in. long is rather an arbitrary unit. It would be more convenient to use a unit independent of the length of fibres weighed. One such unit, which has the added advantage of making

TABLE 2

Strength of Cotton

Lot	Strength pounds per gram of fibres 0.5 in. long	Standard Deviation as % of mean	Strength pounds-count
1200D1	1840	0.75	11.6
1200B3	1870	0.94	11.8
1200C1	2000	1.76	12.6
1200C3	2060	0.88	13.0
1200A2	2140	1.09	13.5
1102H	2200	1.89	13.9
1101K	2330	2.31	14.7
1100K	2470	1.27	15.5
1100F	2620	1.92	16.5
1100G	2750	1.73	17.3

5 tests for each lot.

TABLE 3

Tests on Lot 1200 B3

Weight milligrams of fibre .5 in. long	Breaking Load pounds	Strength pounds per mgm.	Deviation from mean	Square of Deviation
18.2	35.0	1.93	.06	.0036
18.0	33.7	1.87	—	—
18.2	34.2	1.88	.01	.0001
18.3	33.7	1.84	.03	.0009
17.8	32.6	1.83	.04	.0016
Totals		9.35		.0062

$$\text{Mean} = \bar{x} = \frac{\Sigma x_i}{n} = \frac{9.35}{5} = 1.87 \text{ pounds/milligram}$$

$$\text{Standard Deviation}[18] = \sigma_{\bar{x}} = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n(n-1)}} = \sqrt{\frac{.0062}{5.4}} = 0.0176$$

$$\% \text{ Std. Dev.} = \frac{.0176}{1.87} \times 100 = 0.94$$

comparison with yarn strength most simple, is the strength of fibres equivalent in weight to one-count yarn. In the Typp (thousand yards per pound) system of numbering yarns, a half-inch of one-count yarn would weigh 0.0063 grams. It is only necessary to multiply the strength per gram by this weight to convert to pounds-count strength. These figures are given in column 4 of Table 2.

Effect of Weight.—In dividing the breaking load by the bundle weight, to determine the strength per gram, there is implied the necessary assumption that the strength is directly proportional to the amount of material tested. A priori, this cannot be expected to be true over extreme ranges. Since the bundle strength is less than the mean single fibre strength, then as the size of the bundle is reduced to only a few fibres, the strength should rise. But as the bundles actually tested contained some 10,000 fibres, this effect is not serious. On the other extreme, it was found that in bundles too thick there might occur some fibre slippage, with a consequent decrease in apparent strength.

To determine the magnitude of any effect of bundle size on strength, 24 bundles, ranging in weight from 11.7 to 31.1 milligrams, were broken. The correlation coefficient[19] between weight and strength per unit weight was found to be + 0.004. Consequently, the size of the bundle does not affect the strength per unit weight, and the assumption that the breaking load varies directly with the amount of fibre material is justified.

A torsion microbalance with a capacity of 50 milligrams and a sensitivity of 0.1 mg. was used for weighing. A pan was made out of fine wire and aluminum foil to hold the bundle during weighing. This pan weighed 30 mg.; but since the bundle weights ranged from 13.0 to 18.7 mg., the pan and bundle were within the capacity of the balance. It was found desirable to keep the bundles small during the combing operation, in order to minimize breaking of fibres and the possibility that fibres might be selectively retained by the comb. As a result, the trimmed bundles seldom weighed more than 7 mg., and two or three of these were combined to form the bundle broken.

The chief advantages of the Flat Bundle Test as a means of measuring fibre strength are the speed with which results can be obtained, and the inexpensive equipment required. It was found that the group of five tests on a single bale could be completed in 50 minutes; this includes all the necessary operations from sampling and blending through the computation of the results in the manner indicated in Table 3. Rejection of specimens was necessary less than once in 100 tests.

The equipment has been described above. The three special pieces of apparatus needed (the clamp, the bundle holder, and the jaw adjuster) are easily made, and except for these, only a balance and a breaking machine of the types already present in all textile laboratories are required.

The tests described here were performed in the Textile Laboratory of the Massachusetts Institute of Technology, under the supervision of Professor E. R. Schwarz.

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A Method of Analyzing Charts of the Moscrop Single-Strand Yarn Tester*

By MALCOLM E. CAMPBELL and GEORGE W. FIELD†

Summary

In this paper, a method is described by which record charts produced with the Moscrop single strand yarn tester may be analyzed relatively quickly, easily, and accurately. The mean strength, standard error of the mean, and coefficient of variability of the several hundred observations per chart can be determined with considerable accuracy in a relatively short time and with a minimum of effort. The analysis is made graphically, and is based upon the fact that the strength data obtained with this tester are normally distributed, or practically so. A device for projecting the image of a chart, thus facilitating the analysis, is also described.

Introduction

STRENGTH has long been recognized as one of the more important single elements or criteria of cotton yarn quality. This property is usually measured by one of two general methods, commonly referred to as the skein or lea test and the single strand test. Each of the two methods is useful, and each has certain advantages and limitations.

Without dwelling at length on the relative merits of the two methods of test, it is considered sufficient, for the purpose of this paper, to mention briefly one of the major problems in connection with the successful application of the single-strand test. Test for test, single-strand measurements can be obtained more quickly than skein-strength measurements. However, the considerably greater variability of single-strand breaking strengths makes it necessary to obtain several times as many observations to provide a mean of the same degree of reliability. In turn, a greater volume of data must be analyzed. As a result of these two factors, the net time required for an adequate single-strand test may be so great that either the test is not made, or else an insufficient number of observations is obtained.

Thus, there is a distinct need for greater ease and speed in the testing of the yarns and in the analysis of the data. The Moscrop automatic single-strand yarn tester possesses considerable speed with respect to operation and

* This paper relates to a part of the program of work on cotton utility and standards research under the leadership of Robert W. Webb, Principal Cotton Technologist, Bureau of Agricultural Economics, U. S. Department of Agriculture.

† Senior and Junior Cotton Technologists, respectively, Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.

accumulation of data. Heretofore, however, it has been impracticable to make accurate detailed analyses of these data, and accordingly it has been the custom merely to make rough visual estimates of the mean values recorded on the charts. The method of analysis recently developed and here presented provides a relatively rapid and practical means of accurately analyzing the results obtained with this machine.

The Moscrop Tester

The Moscrop single-strand yarn tester has been in use in this country for many years, and its operation is familiar to many textile laboratory workers. Bowman described the machine quite fully in 1908,[1] and except for a few details to be mentioned later, the latest model is essentially the same as the earlier ones.

With the use of this device, a series of breaking strengths is determined for each of six bobbins of yarn. The operation of the machine is completely automatic, and includes the loading of the strands of yarn in the jaws, the application of the force and the recording of the breaking strength of each strand. In the older model of Moscrop tester, the tension is applied by pulling one end of each strand of yarn, the other end of which is connected, through a light carriage mounted on rollers, to a coil spring. The breaking strength in ounces is recorded as the extension of the spring at the moment the break occurs. This extension is recorded on a calibrated chart by means of a pin, which punctures the chart once during each cycle of operation. The older type of machine will record either 80 or 160 breaks per bobbin per chart, depending upon the setting of an adjustable stop.

In the newer model of Moscrop tester, the load is applied by pulling the strands of yarn against a series of weights and levers instead of springs. The breaking strengths are recorded by inked pens instead of perforating pins. Provision is also made, if desired, for recording on a second chart the elongation of each strand of yarn at the maximum load.

Probably the major objection to the use of this type of tester for laboratory work of a precision nature has been the lack of a practical means of analyzing the charts. A chart contains six graduated spaces, each 2-in. square, for the test records. The six groups of closely spaced pinholes on a chart present a rather formidable appearance, and it has been the usual practice merely to estimate the mean of each group by general observation. It is impossible to guess at the degree of dispersion of the perforations with any consistent accuracy, so that this measure has had to be ignored, except when it was desired to make direct visual comparisons of individual blocks. Thus the value of this method of testing cotton yarn has been very limited because of the lack of means of obtaining accurate quantitative measurements of the results.

New Method of Analyzing Charts

In the co-operative cotton spinning research laboratories of the Bureau of Agricultural Economics, a method has been devised for analyzing the Moscrop charts which it is believed possesses sufficient accuracy and speed to make the use of the machine practical in both research and routine test-

ing. It is the purpose of this paper to describe briefly the background of the method, and to explain a working plan of using it. The details apply to the type of machine employing the perforating recorder, although the method is also applicable, with minor modifications, to the type using the pen recorder.

From an examination of several thousand individual observations, the values of which were carefully estimated to a tenth of a graduation on the chart with the use of a reading glass, it was found that the observations obtained with the Moscrop tester tend to distribute themselves according to the normal probability curve. Such being the case, all of the facts that have been established with respect to this curve, apply also to the data obtained with this machine. It can be demonstrated, for example, that 68.27%, or about two-thirds, of the observations in a normal distribution fall within a range of plus and minus the standard deviation (S.D.) from the main or average; the remaining one-third fall outside of this range, one-half of them being below the mean and the other half above.[2] Fig. 1

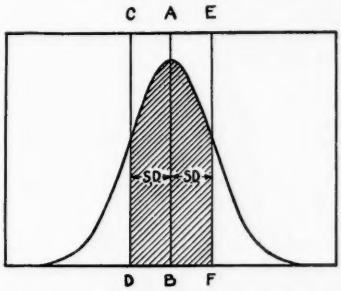

FIG. 1. The shaded area, with abscissas of plus and minus the standard deviation from the mean, AB, contains 68.27% or about two-thirds of the observations in a normal distribution.

illustrates these facts. The complete curve represents the normal probability curve, and the line AB, the position of the mean. Lines CD and EF are drawn parallel to AB and a distance equal to minus and plus, respectively, the standard deviation from it. The shaded area of the curve between CD and EF constitutes 68.27% of the whole area under the curve.

An adjustable stop on the Moscrop tester permits the number of observations per chart to be changed, and it has been found in connection with the method of analysis under consideration that 80 per bobbin per chart is a convenient number to use. On an average, about 68% or 54 of the observations will fall within plus and minus the standard deviation from the mean; 13 will fall below, and the remaining 13 will fall above this range. We can readily determine the two points on the chart above and below which, respectively, 13 observations lie. The difference between these two points is considered to be twice the standard deviation, and the mean to be midway between them.

Occasional yarn slippages occur when the Moscrop machine is used, resulting in faulty observations. In most cases these are readily detected

on the chart, and should be rejected when the analysis is made. The number of slippages is subtracted from 80, and the remainder is divided proportionately to the figures mentioned in the preceding paragraph.

Fig. 2 illustrates this method as applied to an actual section of a chart made with the Moserop tester. Of the 80 recorded observations, C is the 13th from the top, and D, the 13th from the bottom. These are considered to be a distance of 2 x S.D. apart, and the mean to be midway between the points, as shown at EE. Thus the mean and standard error of the mean of the observations for one bobbin of yarn can readily be determined. (The standard error is the standard deviation divided by the square root of the

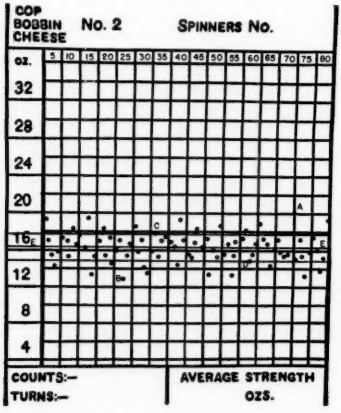

FIG. 2. Enlarged single record from Moserop chart.[1]

A.—Highest observation, representing maximum recorded break.
B.—Lowest observation, representing minimum recorded break.
C.—Thirteenth observation down; upper limit of standard deviation.
D.—Thirteenth observation up; lower limit of standard deviation.
EE.—Value of mean; midway between C and D.

number of observations.) Moreover, it is a simple matter to combine the data for each of the six bobbins to give the mean and standard error for the whole chart.

This graphic method of analyzing the charts made with the Moserop single-strand yarn tester appears to be remarkably simple and rapid if one has spent any length of time in calculating the mean and standard error of large volumes of data by other methods. However, it has been demonstrated that the differences between the results obtained by this method and by the laborious and time-consuming method of evaluating each observation are insignificant.

[1] Positions of pin-holes in this illustration are indicated by black dots, for clarity.

Projecting Device and Its Use

The following description applies to a device used for observing the charts made with the testing machine that is equipped with springs and the perforating principle of recording; but, with minor modification it can be used for charts made with the machine when equipped with weights and levers, and pen recorders.

The instrument may best be likened to a vertical lantern slide projector with a short working distance. It projects a magnified image of the record on to suitably ruled paper, on a drawing board so placed that the working edge of a T-square moving vertically across the board will be parallel to the projected strength graduations of the chart.

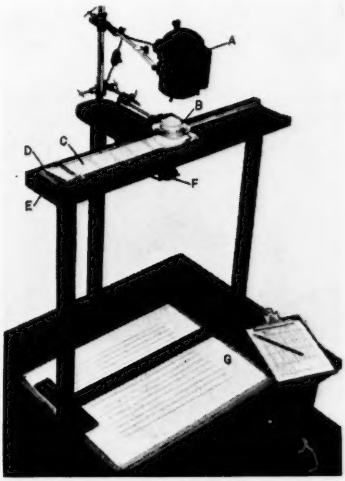

FIG. 3. Experimental model of device for projecting enlarged image of chart made with pinhole type recorder.

A—Lamp
B—Condensing lens
C—Moscrop chart
D—Chart carrier
E—Track
F—Objective lens
G—Ruled paper

Fig. 3 shows the present experimental model of the instrument. Light from the lamp, A, traverses the condensing lenses, B, and is focused on the objective lens, F. The chart, C, is placed on the glass upper surface of a carrier, D, movable only along a horizontal track, E, in which there is a rectangular opening directly beneath the lamp. As the carrier is moved along the track, a record of the observations for a particular bobbin can be brought over this opening. The plane of the chart is at such a distance above the objective that light completely covers a record. The entire

assembly is at such a height that the magnified image of the record is in focus on the paper, G, below, as this arrangement furnishes maximum illumination. By a proper selection of the objective lens, any desired magnification can be obtained. When satisfactory conditions have been attained, lines coincident with those projected from a perfect chart may be ruled on the paper (Fig. 3), or, a graduated scale may be drawn at one side (Fig. 4).

The chart (right side up, lowest graduation farthest from the operator) is inserted under the spring clips of the carrier, with its top edge against the back stop. The chart is set by the same edge in the chart reader and in the Moscrop machine, and since the lines on the drawing board are ruled over those projected from a perfect chart, any inaccuracy due to faulty printing or trimming of the chart being read is automatically corrected. Each record in turn is brought into the reading position and data are recorded on a suitable form. From the known total number of observations made in one run of the machine is subtracted the number of slips or

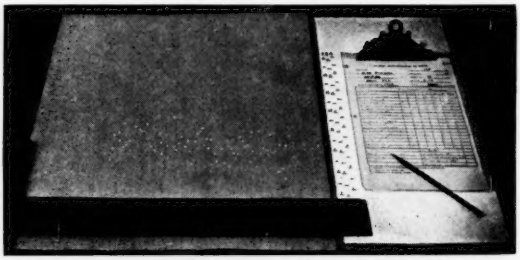

FIG. 4. Close-up view of table top, showing projected chart image, T-square, graduated scale, and record form.

otherwise discarded observations. The whole number nearest to one-sixth of this remainder is the number of observations to be set off from each extreme (top and bottom) of the record. The breaking strengths indicated at these points are read from the ruled graduations, as are the maximum and minimum breaking strengths. Thereafter the calculations are made in accordance with the theory previously outlined.

It is necessary to modify the procedure outlined somewhat when using the new type of Moscrop machine, equipped with weights and levers and pen recorders. To avoid difficulty from having the ink lines run together, it is advisable to record 40 observations instead of 80 in one block, testing only three bobbins at a time on alternate spindles. The bobbins are then shifted to the other three spindles and a second series run off, giving a total of 80 observations per bobbin. A single analysis is then made of the 80 observations. Because of the opacity of the paper, the projecting device is so constructed that a pair of mirrors throw a reflected image on the lower side of a ground glass screen. However, with sufficient illumination the charts may be read with transmitted light, as in the case of the instrument previously described. Although the new charts differ from the old in that the lines are not uniformly spaced, the method of analysis is not affected.

in any way as long as the mean and standard errors are calculated from the values of the 13th highest and 13th lowest observations, instead of graphically on the chart image.

A close-up view of the table top of a finished model of the chart reading device, which has proved to be very satisfactory for routine work, showing projected chart image, T-square, graduated scale, and record form, may be seen in Fig. 4. The table is fitted with a light which is located below a sheet of ground glass set even with the top of the table. This provides a means for illuminating the record form without affecting the projected chart image.

A data sheet used in the laboratories of the Bureau of Agricultural Economics provides space for the data taken from the chart, and also for the various statistical calculations. Thus, it is possible to determine the mean strength, standard error of the mean, and coefficient of variability for each bobbin; and with the use of the few additional calculations outlined on the form, to determine these statistics for the chart as a whole.

References

1. Bowman, F. H. "The Structure of the Cotton Fibre in its Relation to Technical Applications," pp. 303–306. MeMillan & Co., Ltd., London, 1908.

2. Mills, F. C. "Statistical Methods Applied to Economics and Business," p. 538. Henry Holt & Co., New York, 1924.

(*Continued from page 420.*)

A NOTABLE feature of the annual meeting of the National Association of Cotton Manufacturers at the Copley Plaza Hotel, Boston, October 6, will be a discussion of "Vertical Integration in the Textile Industries." Fessenden S. Blanchard, chairman of the Institute's Committee on Economic Research, which suggested and organized this research and acted in an advisory capacity during its conduct at the Wharton School of Finance and Commerce, will lead the discussion, and Prof. H. S. Davis of the Industrial Research Department of the Wharton School will also speak. This study was financed and its results published by the Textile Foundation. The report in a book of 140 pages can be had at $1.50 a copy by addressing Industrial Research Department, 3440 Walnut St., Philadelphia, Pa.

* * *

THE speaker at the meeting of the American Association of Textile Technologists, to be held October 5 at the Architectural League Club, New York, N. Y., will be E. R. Schwarz, professor of textile engineering, Massachusetts Institute of Technology, his subject being "Frontiers of Modern Textile Technology." The extent to which modern textile technology has progressed will be outlined and then the new developments in science will be discussed under the headings of Frontiers of Testing, Frontiers of Laboratory Data and Their Interpretations, Frontiers of Textile Microscopy, Frontiers of Chemistry and Frontiers of Physics. No one branch of science may longer be depended upon to give anything like a complete picture of the field of textile research. It becomes increasingly important and necessary that the physicist, engineer, biologist, chemist, and general technologist work hand in hand for the solution of the pressing problems of import to the industry.

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I. Fibres (Synthetic and Natural) and Fibre Analysis

Photochemical Reactions of Wool. Milton Harris and Arthur L. Smith. *B. S. J. Rsch.*, April 1938, P. 563–9; *Am. Dye. Rptr.*, April 4, 1938, P. 175–8.

In an earlier paper, the authors suggested that in the photochemical deterioration of wool, a portion of the sulfur is converted to hydrogen sulfide, some of which is subsequently oxidized to sulfuric acid. The present paper describes an apparatus which was developed for the purpose of segregating these reactions and testing the hypothesis. The results obtained with it show that in an atmosphere of purified nitrogen, hydrogen sulfide is evolved from wool during irradiation. In the presence of air the bulk of the hydrogen sulfide is oxidized to sulfuric acid. The rate of evolution of hydrogen sulfide is increased by the presence of moisture. The data suggest that the primary action of the radiation is an activation of the disulfide group, resulting in a change in the state of the sulfur. A secondary process, involving the evolution of hydrogen sulfide from the irradiated wool, then occurs. Water does not appear to be essential to the process which involves changing the state of the sulfur, but it may play an important part in the secondary reactions. (C)

POLYSTYRENE: PREPARATION, PROPERTIES AND USES. *Brit. Plastics*, 1938, V. 9, P. 477–8; abs. in *J. T. I.*, May 1938, P. A262. (C)

PROTEIN MOLECULE: STRUCTURE. F. Halle. *Kolloid-Z.*, 1937, V. 81, P. 334–49; abs. in *J. T. I.*, March 1938, P. A179.

A review of investigations on the protein molecule is given with a list of some 220 publications, 177 of which deal with X-ray structure. (C)

RAW MATERIALS FOR THE PRODUCTION OF SYNTHETIC FIBRES. Otto Mecheels. *Mell. Textilber. (German ed.)*, 1938, No. 7, P. 579.

Comparison of the Debeye-Scherrer X-ray diagrams of casein and of fish albumin respectively shows that the structure of casein is practically amorphous, while fish albumin shows the formation of rings and even identity periods. Diagrams of fibres composed entirely of casein and fish albumin showed that the fish albumin fibre at least possesses a certain degree of orientation. The diagram is similar to that of wool, but the difference between the diagram of casein and that of fish albumin fibre is less than that between the latter and that of wool. Comparison of the resistance of these two 100% albumin fibres to wear with the aid of an apparatus illustrated for the measurement of transverse stability, revealed that fish albumin fibre is about 7% more resistant to wear. (C)

RAYON AND STAPLE FIBRES: SWELLING. W. Weltzien and C. Faust. *Monatsh. Seide u. Kunstseide*, 1937, V. 42, P. 481–8; abs. in *J. T. I.*, March 1938, P. A165. (C)

RAYON: DRY AND WET STRENGTHS. Y. Konosi. *J. Soc. Chem. Ind. Japan*, 1937, V. 40, P. 408B; abs. in *J. T. I.*, March 1938, P. A168.

The strengths of dry and wet viscose rayon were determined by tests on continuous threads. It is concluded that the bindings of the structure elements in the rayon fibres that are responsible for the strength are not uniform but must be of various types. (C)

SILK FIBROIN: PROPERTIES. H. Kaneko. *J. Agric. Chem. Soc. Japan*, 1937, V. 13, P. 208–15, 217–24 (through *C. A.*, 1937, V. 31, Col. 7657); abs. in *J. T. I.*, May 1938, P. A298.

(1) Zimmermann's reagent (phthalaldehyde and hydrochloric acid) gives a violet color with sericin and fibroin-A, pink with fibroin-B, and no color with completely degummed silk. The reagent serves in tests for damage to fibroin and effects of alkalis, acids and salts have been examined. (2) The viscosity of solutions of fibroin fractions in Loewe's reagent has been studied. Fibroin-A is similar in many physico-chemical properties to sericin. (C)

SOLUBILITY AND SWELLING OF CELLULOSE AND ITS DERIVATIVES. E. Guth and Z. A. Rogovin. *Colloid J. (U.S.S.R.)*, 1937, V. 3, P. 327–35; abs. in *Paper Trade J.*, April 28, 1938, P. 89.

A discussion of some data in the literature. Differences in solubility are due to changes in molecular volume, to mutual dipole interaction and to steric effects. (C)

SOLUBILITY OF CELLULOSE AND ITS ESTERS. S. Papkov, Z. Rogovin and V. Kargin. *J. Phys. Chem.* (*U.S.S.R.*), 1937, V. 16, P. 156–7; abs. in *Paper Trade J.*, April 29, 1938, P. 90.

The temperature dependence of the solubilities of cellulose and its esters in organic liquids obeys the laws applying to two mutually soluble liquids. Solvents and non-solvents for acetylcellulose show upper and lower critical temperatures. (C)

II. YARNS AND FABRICS

POWDERED FIBRES: PREPARATION AND APPLICATION TO FABRICS. P. Courtade. *Tiba*, 1938, V. 16, P. 119–27; abs. in *J. T. I.*, June 1938, P. A348.

The use of powdered fibres for the manufacture of imitation suede, velvets and similar materials is briefly discussed and a general account is given of the preparation and dyeing of cotton, wool, silk and rayon powders, the preparation of gelatin, starch product, drying oil, and rubber adhesives, and the application of the adhesives and powdered fibres to fabrics. (C)

PROTEIN PLASTIC: APPLICATION IN PERMANENT FINISHES. L. Bonnet. *Teintex*, 1937, V. 2, P. 679–87; abs. in *J. T. I.*, March 1938, P. A153.

Patents relating to the production of plastic products resembling horn, ivory, celluloid, rubber, leather, etc., from albuminoid materials, particularly materials prepared from casein, glue and gelatin, and blood, are reviewed and it is pointed out that a study of these will give finishers ideas for the production of permanent finishes on fabrics. The plastic products can be used to produce pattern effects on fabrics and are particularly useful in the finishing of upholstery fabrics. (C)

RAYON SIZING: TECHNOLOGY OF—IN ALL ITS BRANCHES. I. PURPOSE AND REQUIREMENTS OF SIZING. Carl-Heinz Fischer. *Silk J. & Rayon Wld.*, April 1938, P. 20–2.

The first of a series of articles by this German authority, and described in an editorial note as designed to provide "in concentrated form a practical and scientific treatise summing up the knowledge and experience embodied in thousands of literary contributions." In the first article practically all of the references are German. A large part of this article is given over to the use of paraffin, wax and other similar candles for laying the fibres of warp yarns, although the author admits that this is a makeshift and dangerous practice. Presumably the next article, on methods of sizing, will be equally German in its emphasis upon linseed oil sizes. According to the author "sizing is an impregnation, by which certain products penetrate the fibre structure, consolidate it internally during drying and surround it with a protective layer which provides resistance to mechanical influences during weaving and preserves the natural properties of the thread." It will be interesting to see to what extent he can demonstrate the scientific accuracy of this definition. (C)

RAYON YARNS: WARP SIZING. H. Christoph. *Kunstseide*, 1938, V. 20, P. 85–9; abs. in *J. T. I.*, June 1938, P. A333.

The warp sizing of rayon yarns is discussed and an account is given of comparisons of the efficiencies of linseed oil, protein, and polyvinyl alcohol sizes for the sizing of rayon yarns by hank and warp sizing processes. The efficiencies were compared by weaving sateens with the sized yarns. Lower concentrations of the polyvinyl alcohol sizes were required than of the protein sizes. The sizing action of the protein sizes increases with increasing concentration, rapidly at first and then more slowly, and the curve appears to be uninfluenced by the origin of the protein preparation and by the degree of degradation. A similar influence of concentration of protein size is observed in the warp sizing process, but the maximum sizing effect is reached earlier. The protein and polyvinyl alcohol preparations give much better results than linseed oil size in warp sizing processes. The polyvinyl alcohol sizes, although having a lower efficiency than the protein sizes, have advantages in low concentration requirements and in the soft, smooth handle of the sized goods. The evaluation of a size by tests on the size film, the size solution and the sized yarn is discussed and it is pointed out that adhesive power of the size film, concentration of the size, sliding resistance of the sized yarn, the effect of the size on the extensibility of the yarn, and the chemical nature of the size and its affinity for the fibre material have some relation to the behavior of the yarn in the weaving process. Various sizing preparations are compared in respect of these properties. (C)

ROPE: SOME FUNDAMENTAL FORMULAE IN THE CONSTRUCTION OF. David Himmelfarb. *Cord Age*, 1937, V. 30, No. 6, P. 15–34; 1938, V. 31, No. 1, P. 12–4; abs. in *J. T. I.*, March 1938, P. A137.

Formulae used in construction of four-strand ropes have been developed. The strand diameter is $\frac{1}{7}$ the rope circumference and the number of yarns per strand can be obtained from the formula $\frac{C^2}{12.3} \times$ yarn number. As for the three-strand rope, the cosine of the angle of lay determines the ratio of the yarn or strand length required for a given length of rope respectively, the angle of lay being calculated from the yarn or strand diameter and the turn in the strand or rope. In the construction of cable-laid ropes primary ropes are used in lieu of strands, these being twisted together to form the rope. Cable-laid ropes are harder and more compact than hawser-laid ropes. Formulae for determining the size of secondary strands and primary ropes used in laying the cable have been developed. The cosine of the angle of lay determines the necessary lengths of primary ropes, secondary strands, and yarns, in the cable, the angles of lay being about the same as corresponding angles for hawser-laid ropes. (C)

SHRINKAGE: AN UNUSUAL CASE OF. T. F. Heyes. *Tex. Recdr.*, April 6, 1938, P. 37.

Relates to possible causes of variations in the length of rayon and cotton fabrics after storage. (C)

SOAKING RAYON YARN. Anon. *Tex. Wld.*, Mar. 1938, P. 70.

It is claimed that difference in take-up of oil and gelatine necessitates strict control of standing-bath method. (C)

STATIC CHARGES ON FIBRES: CAUSES AND REMOVAL. E. Meister. *Mell. Textilber.*, 1938, V. 19, P. 21–8; abs. in *J. T. I.*, April 1938, P. A201.

The occurrence of electrostatic charges on fibrous materials and their disturbing effects in textile processes are discussed, and various methods and devices for removing or neutralizing the charges are briefly described. Experiments with combed sliver have shown that charges arise when the sliver is drawn out without contact with metal or other materials. The results of measurements of the charges arising in this way in different types of wool at different humidities are shown graphically and it is pointed out that a relation can be traced between the hygroscopic properties and the electrostatic sensitivity of the wools. The importance of maintaining a sufficiently high humidity to retard charging of the fibres is emphasized. An ionizing device for neutralizing charges on wool in gill boxes is described. The advantages of oiling the wool are pointed out. A device for measuring charges on yarns on spinning frames is described and also the results of measurements on various fibres. In contrast to the other fibres, cellulose acetate staple fibre acquires a negative charge. On the worsted spinning frame the cellulose acetate staple fibre acquires a higher charge than wool while the charge on the Cuprama yarn is much lower than that on wool and causes no difficulty in the spinning process under the conditions studied. (C)

STAPLE FIBRE WARPS: SIZING AND WEAVING. H. Schwarzwälder. *Kunstseide*, 1938, V. 20, P. 26, 28; abs. in *J. T. I.*, April 1938, P. A207.

Ways of increasing production in the weaving of staple fibre materials are discussed and the need for good regular yarn is emphasized. Precautions to be taken in sizing, winding, warping and beaming processes are described. Size recipes are given. Loom speeds suitable for yarns of different fineness are indicated and the use of loose reed looms is recommended. (C)

SWEDISH HÅLKRUS FABRICS: STRUCTURE. R. Künzl. *Mell. Textilber.*, 1938, V. 19, P. 38–9; abs. in *J. T. I.*, April 1938, P. A210.

The Swedish Hålkrus weave is derived from a plain weave by causing groups of picks to float periodically on the back of the fabric in such a way as to produce on the face of the fabric warp floats which however are not visible to the eye. The floats are arranged in chess-board fashion. Between the groups of picks showing periodic floats are weft threads which are bound in plain weave throughout the width of the fabric. These weft threads become drawn together in the places where the warp floats occur, and owing to the chess-board distribution of the latter, assume a wavy form in the fabric. The resulting fabric has the appearance of being composed of an open-work surface fabric with a plain weave fabric showing through the spaces. This effect is increased by using fine yarns for the warp and floating weft threads and thick yarns for the other weft threads. Yarns of different colors may also be used. Various examples of this type of weave are shown. The fabrics are suitable for upholstery fabrics, covers, curtains, etc. (C)

(NEWER) TEXTILE FINISHES. Richard J. Smith. *Canadian Text. J.*, June 10, 1938, P. 33–6.

Address before Canadian Association of Textile Colorists and Chemists, Quebec Section, May 14, 1938. A survey of new chemical products, in-

cluding cellulose ethers, synthetic resins, waterproofing and softening agents which provide novel fabric effects. (C)

WARPING ROLLER: WEIGHT DETERMINATION AND INFLUENCE ON YARN TENSION. A. Rossit. *Mell. Textilber.*, 1937, V. 18, P. 958–9; abs. in *J. T. I.*, March 1938, P. A141

Curves are given showing changes in yarn tension as the yarn is drawn off from the rollers used in warping for rollers of different weights. It is pointed out that by the selection of a roller of suitable weight it is possible to obtain practically the same yarn tension at the end as at the beginning of the unwinding operation. A formula is deduced for the calculation of the most suitable roller weight. It is further pointed out that the most favorable tension relations arise when the ratio of the radius of the full to that of the empty roller is small. (C)

WOOL: CHANGES IN THE CHEMISTRY OF THE FINISHING OF. J. Nüsslein. *Mell. Textilber. (German ed.)*, 1938, No. 7, P. 582.

The author is of the opinion that the development of synthetic fibres composed of albumin should lead to products that differ from natural albuninous fibres. The newly developed auxiliary products are leading the finishing of wool along new paths. The isoelectrical scouring of wool, an important innovation which ensures gentle treatment of the fibres, has already been introduced into mill practice. The familiar diazo reaction introduced by Pauly is recommended for the detection of injury to wool; according to this method, the consumption of diazo solution indicates the extent to which the fibres have been injured. The article then deals with the typical injury to wool fibre caused by hypochlorite and sulphuryl chloride and the effect of these chemicals upon Lanital and other synthetic albumin fibres. Detergents of the latest type containing no sulpho groups are especially suitable for washing and dyeing wool, owing to the fact that these products are not absorbed by the wool fibre and there is no stoppage or reversal of the washing process. (C)

WOOLEN YARNS: REDUCING COUNTS VARIATION OF. G. Marshall. *Tex. Mfr.*, May 1938, P. 183, 198.

Suggests limits of variations in counts, sources of variation, and practical methods of avoiding excessive variation. (C)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

LANITAL: DYEING. *L'Ingénieur Text.*, 1937, No. 339, P. 464–7; abs. in *J. T. I.*, March 1938, P. A151.

The general methods of dyeing Lanital with acid, chrome, Neolan and direct dyes, and Lanital-wool mixtures with Neolan, acid and chrome dyes are briefly described. (C)

LANITAL WOOL MIXTURES: DYEING AND PRINTING. J. Lanzer. *Mell. Textilber.*, 1938, V. 19, P. 73–5; abs. in *J. T. I.*, May 1938, P. A285. (C)

OXIDATION, REDUCTION AND HYDROLYSIS OF WOOL KERATIN. M. Barr. *Iowa State Coll. J. Sci.*, 1937, V. 12, P. 106–7; abs. in *J. T. I.*, June 1938, P. A321.

Data are given of the change in composition and mechanical strength of wool keratin brought about by hydrochloric acid, sodium chloride, steam, sodium hydrosulphite and potassium permanganate. (C)

PROTECTIVE TREATMENT OF WOOL DURING FINISHING. E. Elöd and H. Reutter. *Mell. Textilber.*, 1938, V. 19, P. 67–72; 1938, *Ibid., English Ed.*, P. 29–33; abs. in *J. T. I.*, May 1938, P. A284.

The isoelectric point of wool lies at pH = 4.9. Even relatively slight injury to wool can be determined by the Elöd-Haas method from the speed of adsorption of suitable acid dyes. Treatment of wool with concentrated ammonia until it breaks down into fragments does not alter either the isoelectric point or the dyeing properties of these fragments, but the speed of dyestuff absorption is correspondingly raised to a very high level. Swelling of wool does not affect the equilibrium of the dyeing, but only its rate of absorption. The theory of dyeing developed by Elöd and his co-workers is by no means decisively influenced by swelling phenomena. (C)

"RAYOLANA" STAPLE FIBRES: DYEING PROPERTIES. C. M. Whittaker. *Text. Wkly.*, 1938, V. 21, P. 380, 383; abs. in *J. T. I.*, May 1938, P. A283.

General rules for the dyeing of "Fibro" are given and suitable machines for dyeing in the various forms from fibre to finished pieces are mentioned. "Rayolana" is a staple fibre with wool-like dyeing affinity and properties. It also has a pronounced affinity for many cellulose acetate dyes, especially the Solacet range. "Rayolana" possesses a much greater affinity than "Fibro" for basic, direct cotton, sulphur, azoic, vat and Soledon dyes. (C)

RAYON AND STAPLE FIBRE: LEVEL DYEING. W. Weltzien and K. Windeck-Schulze. *Monatsh. Seide u. Kunstseide*, 1938, V. 43, P. 63–76; abs in *J. T. I.*, May 1938, P. A283. (C)

SINGLE-BATH WATERPROOFING AGENTS: EFFICIENCY. K. Quehl. *Mell. Textilber.*, 1937, V. 18, P. 1001–3; abs. in *J. T. I.*, March 1938, P. A154.

The development of single-bath impregnation processes for the waterproofing of textile materials and the testing of the treated fabrics are briefly discussed. It is pointed out that when comparing the efficiencies of different waterproofing agents determinations should be made of both the amount of water absorbed by the treated sample and the amount passing through it. Results showing the effects of the use of different concentrations of the waterproofing agents are also given and discussed. Further tests have shown that the stage at which alumina is added, *i.e.*, whether to the concentrated emulsion or to the diluted emulsion in the impregnation bath, has practically no influence on the efficiency of the proofing treatment. (C)

SPONTANEOUS COMBUSTION OF TEXTILE FIBRES. *Klepzig's Textil-Z.*, 1938, V. 41, P. 36–7; abs. in *J. T. I.*, April 1938, P. A252.

In most cases spontaneous combustion can be traced to the presence of fats, oils and higher fatty acids, linseed oil being especially dangerous.

The fire danger of oleins is due to the presence of lactones. Contributory factors in the rise of temperature may be the activity of micro-organisms and the presence of moisture. The influence of various dyeing processes is explained, tannin, fustic, logwood, catechu, and substantive and sulphur dyestuffs, in all cases used alone, having no effect. Iron, copper, manganese, lead and chromium may promote spontaneous combustion when these metals do not form part of the dyestuff molecule. Of antioxidants, β-naphthol has a retarding and α-naphthol and diphenylamine a preventive effect. Hydroquinone is the only compound which definitely stops the auto-oxidation of all fats and oils, except linseed oil. Light of all wave lengths has an activating influence on the decomposition of fats and oils, green light having the least effect. (C)

TENDERING ACTION OF LIGHT ON TEXTILE FIBRES. Wm. H. Cady. *Am. Dye. Rptr.*, June 13, 1938, P. 325–7.

Presented before Northern N. E. Section, A. A. T. C. C., Boston, March 4, 1938. At a recent meeting of the Research Committee of the A. A. T. C. C. a discussion regarding the action of ordinary sunlight and ultra-violet light upon both dyed and undyed cotton led to the appointment of a special committee, to investigate this subject. William H. Cady was appointed chairman of such a committee, and this paper, while not submitted as a report, presents an excellent review of the subject. Mr. Cady will appreciate receiving comments upon his paper, or facts or statement of experiences in regard to the action of light upon dyed fibres, which may be of interest to his committee. (C)

UREA-FORMALDEHYDE RESIN: APPLICATION. L. Molinari. *Maglieria*, 1937, V. 19, P. 301–5 (from *Materie Plastiche*); abs. in *J. T. I.*, March 1938, P. A153.

A new application of urea-formaldehyde resin to textile fabrics is described, which gives increased elasticity and strength (especially in the wet state) to rayon, linen, cotton, hemp and ramie and imparts the handle and draping qualities of wool and silk. Brief details of the method are given and a table shows increase of weight, loss on washing and breaking loads (warp and weft) before and after treatment, for some mixture fabrics containing staple fibre, rayon, cotton or wool. (C)

VAT PRINTING. Raymond W. Jacoby. *Am. Dye. Rptr.*, June 27, 1938, P. 349–52.

Presented at April 29, 1938, meeting of R. I. Section, A. A. T. C. C. Gives results of a survey showing wide discrepancy in application methods, and in costs; also the reasons for these variations. (C)

WASHING ACTION OF SOAP. S. H. Bertram. *Chem. Weekblad*, 1937, V. 34, P. 707–8 (through *Brit. C. A., B*, 1938, V. 57, P. 79); abs. in *J. T. I.*, March 1938, P. A149.

The purifying action of soap depends on its surface tension against air, the interfacial tension against the fabric and against the various kinds of dirt, the frothing power, and the stability of the froth. It has proved practically impossible to devise washing tests which are generally applicable, but useful data can be obtained by measuring the decrease in surface tension

of H_2O by addition of various amounts of soap, the frothing power and the stability of the froth at different temperatures, the wetting power for fabrics and the lowering of the interfacial tension of H_2O against a large number of substances (drop number). It is considered that this last method is not sufficiently used in practice. (C)

WOOL: ACTION OF ALKALIES ON. *Deut. Wollen-Gewerbe*, 1937, V. 69, P. 1439; abs. in *J. T. I.*, March 1938, P. A167.

The loss of strength of wool with alkaline treatment is dependent on the alkali concentration, but does not increase with increasing concentration. Within the concentrations of increasing strength value there is also an increase of lustre, reaching the maximum at 42° Bé. and at a temperature of 20° C. In comparison with caustic soda, alkali carbonates cause less damage and ammonium compounds no damage at ordinary temperatures. Alkaline earths have a destructive action. Alkali-treated wool has an increased affinity for dyestuffs and this can be obtained even by treating wool with calcium carbonate (0.5%) with exclusion of air. Wool can be protected against the action of alkalies by the sodium salts of lignin sulphonic acids, *e.g.*, Protectol, or by glycerine and formaldehyde. (C)

WOOL FABRIC DYEING: COVERING OF HAIRS IN. *Mell. Textilber.*, 1938, V. 19, P. 183; abs. in *J. T. I.*, June 1938, P. A346.

If, as is often the case, the hairs show only after dyeing, they may be concealed by after-covering with Celliton Fast dyestuffs at average temperature. This, however, diminishes the fastness and changes the shade to a certain extent. If the presence of the hairs is known before dyeing, preliminary mordanting is recommended, using 1–3.5% potassium dichromate and 0.75–3% tartar. Owing to the different light reflection properties of the hairs and the wool, an uneven appearance may result, even with uniform dye absorption. (C)

WOOL: RESERVING—TO OBTAIN SPECIAL EFFECTS IN PIECE DYEING, AND REMOVAL OF RESERVE. *Färber Ztg.*, May 1937 (through *Tiba*, 1937, V. 15, P. 709); abs. in *J. T. I.*, March 1938, P. A152.

The following processes for reserving wool are described: 1. Acetylation of white wool. 2. Immunization of cream-dyed wool with tannic acid and sodium bisulphite. 3. Immunization of dyed wool with tannic acid. In dyeing fabrics containing acetylated or immunized wool, the use of sulphuric acid must be avoided and only organic acids used. The reserve is destroyed, especially in treating rags, by carbonizing the acetylated wool, and working the tannin-immunized wool at the boil in 6% potassium bichromate, 12% sulphuric acid (66° Bé.) and 6% crystallized oxalic acid. (C)

IV. RESEARCH METHODS AND APPARATUS

ANALYSIS OF MIXTURES OF COTTON AND REGENERATED CELLULOSE RAYON. Frank Howlett and A. R. Urquhart. *J. T. I.*, March 1938, P. T43–T54.

The method described in this paper depends essentially on the dissolution of the regenerated cellulose rayons in solutions of sodium hydroxide containing dissolved zinc oxide, at about room temperature. The use of

three solutions is described, two being applicable to mixtures of cotton and viscose rayon, the third to mixtures of cotton and cuprammonium rayon. Of the two solutions suggested for the dissolution of viscose rayon either can be used according to the facilities available; they both give similar accuracy in the result, but to attain this accuracy the first requires greater accuracy in the preparation of the solution and in temperature control, while the second, though permitting rather larger tolerances in these respects, requires rather more care in the manipulation. The first method has been in use in the laboratories of the Shirley Institute and of member firms for nearly two years, and has been found perfectly satisfactory. The second method has been in use in the Institute laboratories for about three months; it is also quite satisfactory, and probably has a wider applicability. A section of the paper describes the development of the methods, gives figures showing the accuracy obtainable, and discusses their applicability to the various cloths and yarns that it may be desired to analyze. A third section describes the experimental procedure in detail. (C)

ANIMAL FIBRES: OPTICAL STUDY. F. O. Schmitt. *J. Applied Physics*, 1938, V. 9, P. 109–17; abs. in *J. T. I.*, May 1938, P. A298.

Polarized light and X-ray diffraction methods are described for the investigation of living tissues. The structure of hair and protein textile fibres is discussed from a consideration of their X-ray diffraction and polarized light analyses. (C)

CELLULOSE ANALYSIS. A COMPARISON OF THREE PRINCIPAL METHODS. J. D. Reid and D. F. J. Lynch. *Ind. Eng. Chem., Anal. Ed.*, Dec. 1937, P. 570–3; abs. in *Paper Trade J.*, May 12, 1938, P. 48. (C)

CHEMICALLY TENDERED COTTON: DETECTION. W. Krause. *Deut. Färber-Z.*, 1938, V. 74, P. 91; abs. in *J. T. I.*, April 1938, P. A229.

A method of detecting injury of cotton produced by hot alkalis and bleaching agents is described which depends on determination of the amount soluble in calcium thiocyanate. (C)

COTTON: DEVICE FOR DETERMINING THE PROPORTION BY WEIGHT OF FIBRES OF DIFFERENT LENGTH IN A SAMPLE OF. N. Ahmad. *Indian Central Cotton Committee Tech. Bulletin, Series B*, No. 23, 1938; *J. T. I.*, April 1938, P. T67–T74.

The cotton stapling apparatus, designed at the Technological Laboratory (Bombay) some time ago, gives the mean length and weight per unit length of a cotton. It, however, suffers from the limitation that it does not give the frequency distribution of length, a knowledge of which is often useful, not only to the research worker, but also to the trade and industry. With a view to remedying this deficiency, a new attachment to the stapling apparatus has now been designed. The description and mode of operation of this device are given in this paper. Further, the results of experiments, conducted with a view to determining the degree of agreement with the other instruments in vogue, are also given. It is shown that this device is capable of yielding consistent results which agree well with those given by the Balls Sorter. (C)

DRYING PROCESS TESTING AND CONTROL DEVICES. R. Setzer. *Mell. Textilber.*, 1938, V. 19, P. 222–4, 314–5; abs. in *J. T. I.*, May 1938, P. A281.

An account is given of methods and devices for testing the efficiency of textile drying processes. The methods used for testing air drying processes depend on measurements of the difference in moisture content of the hot air before and after contact with the goods. For the testing and control of cylinder drying processes, the moisture content of the dried goods is determined from measurements of the dielectric constant of the textile material or from measurements of the relative humidity of the layer of air in contact with the material. In a device useful for control purposes, the variation in the static charge produced on rollers over which the material passes is used to indicate variations in the moisture content of the latter. (C)

V. ECONOMIC RESEARCH AND MISCELLANY

CELLULOSE FIBRES: REFRACTIVE INDICES. I. REFRACTIVE INDEXES OF RAMIE, COTTON, AND COTTON LINTER. II. REFRACTIVE INDEXES OF CELLULOSE HYDRATE. K. Atsuki and S. Okajima. *J. Soc. Chem. Ind., Japan*, 1937, V. 40, P. 360–5B; abs. in *J. T. I.*, Feb. 1938, P. A99.

The results of determinations of the refractive indices of ramie, cotton and cotton linter fibres in directions parallel and perpendicular to the fibre axis by Becke's method are tabulated and discussed. The relation between the pitch of convolution and the refractive index parallel to the fibre axis is examined. It is concluded that the refractive indices of the cellulose micelle in the directions perpendicular and parallel to the micellar principal axis are 1.533 and 1.595. The results of determinations of the refractive indices of ramie fibres mercerized under tension and of the refractive indices of isotropic fibres prepared from viscose and from nitrocellulose are also given, and from these results the refractive indices of the cellulose hydrate micelle are calculated. The values for the directions parallel and perpendicular to principal valency direction are 1.577 and 1.515. (C)

HEATS OF WETTING OF CELLULOSE BY ALCOHOLS AND THEIR AQUEOUS SOLUTIONS. J. L. Morrison, W. B. Campbell and O. Maass. *Can. J. Rsch.*, Nov. 1937, P. 447–65.

The heats of wetting of dry cotton cellulose by several pure and aqueous alcohols have been measured for the first time. The rate at which the wetting occurred was also determined. The results indicate a preferential sorption of water from the aqueous alcoholic solutions. This conclusion is supported by similar measurements in experiments in which absolute alcohols were allowed to wet cellulose containing various amounts of previously adsorbed water. (X)

INTERNAL FRICTION IN SOLIDS. PART II. General Theory of Thermoelastic Internal Friction. C. Zener. *Phys. Rev.*, Jan. 1, 1938, P. 90–9.

Stress inhomogeneities in a vibrating body give rise to fluctuations in temperature, and hence to local heat currents. These heat currents increase the entropy of the vibrating solid, and hence are a source of internal friction. The general theory of this internal friction is here developed. The

simplest example of stress inhomogeneity is that occurring in the transverse vibrations of reeds and wires. Explicit formulae are obtained for reeds and wires, and the effect is calculated of crystal orientation in single crystal specimens. Microscopic stress inhomogeneities arise from imperfections, such as cavities, and from the elastic anisotropy of the individual crystallites. The internal friction due to spherical cavities is calculated. The internal friction due to elastic anisotropy is investigated for cubic metals, and is found to be greatest for Pb, least for Al and W.

PART III. EXPERIMENTAL DEMONSTRATION OF THERMOELASTIC INTERNAL FRICTION. C. Zener, W. Otis and R. Nuckolls. *Ibid.*, P. 100–1.

In order to demonstrate the presence of thermoelastic internal friction, the internal friction of a copper reed over a wide frequency range (50 to 4000 cycles/sec.) was measured. They obtained a maximum precisely at the predicted frequency. The observed variation of internal friction with frequency proves that, over a wide frequency range, the internal friction due to the flow of heat back and forth against a reed is of a larger order of magnitude than that due to all other causes. Independent experiments of Bennewitz and Rotger on wires of Ag, Al, brass, steel, and glass are shown to furnish an equally striking demonstration of thermoelastic internal friction. (X)

PROTEINS: STRUCTURE. W. T. Astbury. *Nature*, 1937, V. 140, P. 968; abs. in *J. T. I.*, Feb. 1938, P. A115.

Brief references are given to X-ray evidence that there may not be a real distinction between "fibrous" and "globular" proteins and it is pointed out that the results of purely chemical methods for determining the number and position of the amino-acid residues, due to Bergmann and Niemann (1936–7), lead to the same conclusion. The author shows how X-ray measurements can supplement the Bergmann argument, and calculates a stoichiometrical distribution of amino-acid residues and provisional molecular weight for keratin. (C)

SILK FIBROIN: X-RAY DIAGRAMS; INTENSITY DISTRIBUTION. C. Matano. *J. Soc. Chem. Ind., Japan*, 1937, V. 40, P. 358–60B; abs. in *J. T. I.*, Feb. 1938, P. A99.

The expression for the intensity distribution of Debye rings is further discussed and the determination of the distribution function of the microcrystals is explained. Practical applications to regenerated silk fibres are given. (C)

STARCHES: STUDY OF THE STRUCTURE, DEGRADATION AND DECOMPOSITION OF. L. H. Fischer and I. Fischer. *Deut. Textilwirtschaft*, 1937, V. 4, No. 15, P. 11–15 (through *C. A.*, 1937, V. 31, Col. 8237); abs. in *J. T. I.*, Jan. 1938, P. A17.

A detailed review of the chemistry involved with particular consideration of the use of starch in the textile industry. (C)

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